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I. REFERENCES:

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II. PRIMARY POWER DISTRIBUTION

1. A new transformer station is installed near the power building to include the following:

   a. A new 300 KVA transformer bank to furnish 277/480V power for the technical loads.

   b. A new 500 KVA transformer bank to furnish 120/208V power for the utility loads and alternate for technical loads.

   c. A new 13.8 KV 3Ø underground ductline is run from the nearest existing power manhole to the new transformer station.

2. Existing fenced enclosure including steel structure, fuse cutouts, potheads, etc., will be removed. Metering to be relocated.

III. POWER BUILDING

1. A new 175 KW 3Ø No-break generating set is installed in the new Building Addition to replace existing 100 KW No-Break unit. Input voltage to motor is 480V while generator is 3Ø 4W 120/208 volts. Generating set is government-furnished.

2. A new government-furnished 235 KW generator is installed to replace existing 100 KW generator #2.

3. Existing 235 KW generator #1 to remain.

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III. POWER BUILDING (Cont'd)

4. A new government-furnished switchboard is installed in the existing building where the 100 KW No-Break unit is presently installed. Switchboard includes the following:

   a) Preferred distribution panel to feed all the technical loads.

   b) Normal distribution panel to feed all the utility loads.

   c) Main breakers to permit throw-over from base power to no-break power for technical loads, from base power to emergency generators 1 and 2 for utility loads, and from no-break power to emergency generators 1 and 2 upon failure of no-break generating set.

5. A new government-furnished resistor bank is installed in the transformer station enclosure to serve as dummy loads for testing the different generators.

6. All existing transfer switches, automatic or manual, are to be removed.

7. A new lighting panel is installed to furnish 120/208V power to the additional lights, receptacles, battery chargers, etc.

8. A new cable trench is installed to accommodate all the necessary wires.

9. Remote status cabinets (G.F.E.) for the switchboard and the no-break unit are installed in the Receiver Building.

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IV. SECONDARY DISTRIBUTION

New feeders are installed from the new switchgear for the following leads in the Receiver Building:

1. Panel MP (Utility)
2. Panels "PP" & "LC" (Utility)
3. Max. 1 400-cycle generator "B" and screen room panel (Technical).
4. Max. 1 400-cycle generater "A" and A/C (Utility)
5. Panel "PC" (Utility)
6. Panel "PE" 'Utility)
7. Panel "PF" (Conduit only)
8. Remote status cabinets for switchboard and no-break unit (control wires).

V. UTILITY LOADS AT RECEIVER BUILDING

Description	Dem. KVA
Panel "MP"	56.0
Panel "PC"	69.3
Max.-1 "A" source and A/C	28.0
Panels "PA" & "PD"	16.0
Panels "PE"	77.0
Panels "PP" & "LC"	44.0
Warehouse	30.0
Total Utility Load	320.3
Future Panel "PF"	69.7
Add Tech. Load - when on base power	110.0
Total	500.0

Transformers required: New 500 KVA 3Ø transformer bank is sufficient.

Generators required: Assume 1-235 KW (300 KVA at 80% P.F.) generator running. At 10% overload capacity of 330 KVA, either generator can carry total utility load of 320.3 KVA.

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VI. TECHNICAL LOADS AT RECEIVER BUILDING

Description	Dem. KVA
Panel "MT"	54 (Approx.)
Max. 1 "B" source and screen room	54 (Approx.)
Total	108

Ammeter readings taken by AWA of total tech. loads indicate 300 amps. at 3Ø 120/208V or 108 KVA.

No-Break Unit (UPS) input KVA from 480V transformer bank

$$\text{Input KVA} = \frac{175 \times 1.1}{0.93 \times 0.9 \times 0.8} = 288 \text{ KVA}$$

Where 1.1 allows for generator, motor and clutch excitation, 0.93 is general efficiency, 0.9 is motor efficiency and 0.8 motor power factor.

Transformer required: Three 100 KVA 1Ø transformers are sufficient.

VII. PANEL "PD" LOADING AT POWER BUILDING

Conn. Load = 14.1 KVA 3Ø 4WSN 120/208V 70% D. F.

Demand Factor Determination

Description	Conn. Load KVA	Dem. Fact. %	Dem. Load KVA
Lights	1.4	100	1.4
Receptacles	0.72	50	0.36
Spares	7.0	50	3.5
Equipment	5.0	100	5.0
Total	14.12	70	10.26

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VIIIA SWITCHBOARD INCOMING FDR. & MAIN BKR. SIZES

FROM	TO	AMPERE LOAD	MAIN BREAKER Pole Size	DISTANCE(Ft.) Fdr. Length	DISTANCE(Ft.) For 1% V. Drop	WIRE (RHWN) Number & Size	Max. Amp.	Calc. % V. Drop
300KVA Trans	Switchboard	362		43	157	3-500 MCM 1 - No. 6	380 65	0.3
500KVA Trans	Switchboard	1386	3P 1000A	20	162	4 x (4-500 MCM)	1420	0.13
Sw'board	175 KW UPS (250 KVA INPUT) *	348	3P 600A	40	162	3-500 MCM 1-No. 6	380 65	0.25
175 KW UPS	Sw'board	600	3P 600A	40	131	2 x (4-350 MCM)	620	0.3
175 KW UPS	Dummy Load	600	-do-	57	131	3 x (3-350 MCM)	620	0.44
Gen. No. 1	Switchboard	920**	3P 1000A	40	128	3 x (4-350 MCM)	930	0.3
Gen. No. 1	Dummy Load (235 KW)	840	-do-	60	140	3 x (3-350 MCM) 3 x No. 1/0	930 390	0.4
Gen. No 2	Switchboards	920**	3P 1000A	32	128	3 x (4-350 MCM)	930	0.25
Gen. No 2	Dummy Load (235 KW)	840	-do-	52	140	3 x (3-300 MCM) 3 x No. 1/0	930 390	0.4

* See IV

** Load = $\frac{235}{.80\ (P.F.)}$ x 1.1 = 330 KVA AT 3Ø 120/208V.

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VIII B SWITCHBOARD FDR. BREAKER SIZES & VOLTAGE DROPS.

CKT NO	PANEL OR LOAD	AMP LOAD		MAIN BKR POLE SIZE	DISTANCE (FEET)		WIRE (RHWN)		
		BKR	FDR		FDR LENGTH	FOR 1% V.DROP	NUMBER & SIZE	MAX. AMP.	CALC % V. DROP
	UTILITY	BUS							
1	MP	200*	168*	3P 400A	111	332	4-500 MCM	380	0.33
2	PC	264**	202**	3P 300A	190	196	3-350 MCM & 1-#6	310 GR	0.66
3	MAX-1 A SOURCE	144Δ	94Δ	3P 250A	112	240	4-#4/0	230	0.47
4	PA & PD	55+	47+	3P 100A	46	102	4-#4	85	0.45
5	PE	300**	260**	3P 300A	120	147	3-350MCM	310	0.82
6	PP & LC	160ΔΔ	130ΔΔ	3P 300A	111	216	4-250MCM	255	0.51
7	WAREHSE	84	84	3P 200A	240	102	4-#2/0	175	2.35
8	FUT. PF	—	—	—	—	—	—	—	—
	TECHNICAL BUS								
1	MT	200	200	3P 250A	40 86	140 284	4-250MCM 4-500MCM	255 380	0.58
2	MAX-1 B SOURCE	200	200	3P 250A	142	112	4-#4/0	230	1.30
3	—	—	—	—	—	—	—	—	—

* LARGEST MOTOR = 10HP 3Ø W/ REDUCED VOLTAGE STARTER

** LARGEST MOTOR = 30 HP 3Ø W/ REDUCED VOLTAGE STARTER

Δ EXISTING MOTOR-GENERATOR SET 20 KW 3Ø

ΔΔ LARGEST MOTOR = 7.5 HP 3Ø

\+ LARGEST MOTOR = 2 HP 3Ø

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IX. PANEL "PD" BRANCH CIRCUITS

Wires are sized so that maximum voltage drop from the transformers to the farthest load shall not exceed 5%.

X. PANEL LOADING (RECEIVER BUILDING)

A. Panel "PC" - Conn. Load 81.6 KVA 3ø 4WSN 120/208V 85% D.F.

Breaker Load = 264 amps. (largest motor = 30 HP 3ø 208V)
Feeder Load = 202 amps. (largest motor = 30 HP 3ø 208V)

Install #6 wires as neutral since A/C control and 1/2 HP exhaust fan are only 120V loads.

Demand Factor Determination:

Load	Conn. KVA	Dem. Factor %	Dem. KVA
Spare	1.0	50	0.5
A/C Control & Exh. Fans	3.2	100	3.2
Cond. Fan & C.W. Pump	18.6	100	18.6
Chiller (2-30 HP)	58.8	80**	47.0
Total	81.6	85	69.3

**Chillers sized 125% of actual demand.

B. Panel "PE" - Conn. Load 88.8 KVA 3ø 3W 208V 90% D.F.

Breaker Load = 300 amps. (largest motor = 30 HP 3ø 208V)
Feeder Load = 260 amps. (largest motor = 30 HP 3ø 208V)

Install 350 MCM RHWN wires with 310 maximum ampacity.

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B. Panel "PE" (Cont'd)

Demand Factor Determination:

Load	Conn. KVA	Dem. Factor %	Dem. KVA
Air Handling Fans	11.4	100	11.4
Condenser Fan	8.4	100	8.4
C. W. Pump	10.2	100	10.2
Chiller	58.8	80	47.0
Total	88.8	90	77.0

C. Panel "PF" (Future) - Conn. Load 77.4 KVA 3Ø 3W 208V 90% D.F.

Loads	KVA
Ch. Water Pump (10 HP)	10.2
Cond. Fan (7½ HP)	8.4
Chiller (2-30 HP)	58.8
Total	77.4

Assume demand factor 90%.

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XI BRANCH CKT. BKR. & WIRE SIZES & VOLTAGE DROPS

CKT. NO.	PANEL OR LOAD	AMP. LOAD		CKT BKR POLE SIZE	DISTANCE (FEET)		WIRE (THW OR RHWN)		
		BKR	FDR		FDR LENGHT	FOR 1% DROP	NO. & SIZE	MAX CAP	CALC % V. DROP
	PANEL "PC"								
PC-1	CONTROL	—	—	1P 20A	—	—	—	—	—
3	EXH. FAN	24.4	12.2	1P 30A	25	29	2 - # 12	20	0.86
4	EXH. FAN	24.4	12.2	1P 30A	74	49	2 - # 10	30	1.50
5	C.W. PUMP#1	57.2Δ	35.7Δ	3P 70A	22	49	3 - # 8	40	0.45
6	COND. FAN#1	58.2	29.1	3P 70A	53	61	3 - # 8	40	0.87
7	CHILLER #1	248.1	186.1	3P 250A	23	95	3 - # 3/0	200	0.24
	PANEL "PE"								
PE-1	A.H. FAN #4	39.8	19.9	3P 40A	47	61	3 - # 10	30	0.77
2	A.H. FAN #5	39.8	19.9	3P 40A	80	61	3 - # 10	30	1.31
3	C.W. PUMP#2	57.2Δ	35.7Δ	3P 70A	33	49	3 - # 8	40	0.67
4	COND. FAN#2	58.2	29.1	3P 70A	51	61	3 - # 8	40	0.84
5	CHILLER #2	248.1	186.1	3P 250A	26	95	3 - # 3/0	200	0.27

DESIGN NOTES:

Δ AMPERE VALUES FOR MOTOR WITH REDUCED VOLTAGE STARTER

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XII. VOLTAGE DROP ON GENERATORS

(Effect of Motor Start)

Assume only Gen. #1, 235 KW running, 1-30 HP compressor to start, no other motor loads.

From Fig. #2.17 of IEEE No. 141 - Elec. Power Distribution for Industrial Plants, minimum voltage of a 235 KW (300 KVA) generator upon start of a 30 HP motor is 83%, thus, a voltage drop of 17%. Together with voltage drops due to other loads (which is of small value), this drop is acceptable for short-time duration.

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XIII ILLUMINATION DESIGN DATA

ROOM NO.	ROOM NAME	LENGTH FT.	WIDTH FT.	CLG. HGT.	MTG. HGT.	RM. RATIO	ROOM AREA SQ.FT.	REQ'D. F.C.	M.F.	C.U.	REQ'D. LUMENS F.C. x AREA / M.F. x C.U.	FIXTURES NO.	FIXTURES TYPE	FIXTURES WATTS	ACTUAL LUMENS	CALC. F.C.
	CHILLER ROOM	29	23	13'-0"	10'-0"	1.6	667	20	0.70	0.62	30700	8	#12	200	29120	18.7
	A/C EQUIPMENT	(50 x 10)	11'-6"	10'-0"	1.7	640	20	0.70	0.61	30000	8	#12	200	29120	19.4	
		-(10 x 8)														
		-(10 x 8)														

SAMPLE COMPUTATION: CHILLER ROOM

REQ'D. LUMENS = $\frac{20 \times 667}{0.70 \times 0.62} = 30700$

USE 8 - 200W TYPE #12

CALCULATED F.C. = $\frac{8 \times 3640 \times 0.70 \times 0.62}{667} = 18.7$

LAMP LUMEN: 200W - 3640

REMARKS

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